Social development benefits of hydroelectricity CDM projects in Brazil

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In recent years, the concept of sustainable development (SD) has become increasingly recognized and important. Within organizations, SD is often portrayed as a balancing act and requires a combination of three elements to be considered: economy, environment, and society. Traditionally, organizational management research has been focused on economical and environmental fronts. However, social aspects are also important for organizations, especially those in emerging and developing countries. The goal of this article is to investigate the potential of Clean Development Mechanism (CDM) projects to deliver social benefits in Brazil's hydroelectricity sector. The investigation involved the assessment of 46 registered hydro CDM projects under the Kyoto Protocol in terms of their potential impact on the envisaged social development goals. Two case studies were also examined. Results indicate that organizations managing hydroelectric initiatives in Brazil can provide the pathway toward achieving a number of important social benefits. Successful projects were found to have good community involvement and were managed by both cooperative ventures and money-making corporations. The research also identified several challenges that are hindering hydro CDM projects from delivering more social benefits and enabled a number of recommendations to be extracted for the organizations facing these challenges.

Keywords: Brazil; CDM hydroelectricity projects; organizational management; social benefits; sustainable development

1. Introduction

In the last 20 years, the concept of sustainable development (SD) has grown in recognition and importance, and numerous alternatives to the concept have been provided (Barkemeyer et al. 2014). Probably, the most widely stated definition of the concept is: development which 'meets the needs of the present without compromising the ability of future generations to meet their own needs' (WCED 1987). However, contest occurs in relation to what these core ideas actually 'mean'.

Previous research on how organizations have come to 'know' SD highlighted that most organizations draw on the concept of balance (Tregidga et al. 2013). Therefore, SD is portrayed as a balancing act, and it requires organizations to consider three combined elements: economy, environment, and society (i.e., the triple bottom line).

Noticeably, the economic perspective is a common realm in business. Finance managers know that a company which does not use its income to pay for its costs will soon be insolvent. From a social or environmental perspective, however, the impact may not be visible in the short term (Silvius & Schipper 2010).

Nevertheless, considerable research suggests that organizations have traditionally focused on the environmental component of SD (e.g., Rondinelli & Berry 2000). Moreover, the increase in environmental incidents has made the world aware that environmental problems affect more than just selected regions, and environmental management (EM) has become a global concern within organizational agendas (Dale 2010). Furthermore, one of the most serious global challenges facing our societies is the need to reduce greenhouse gas (GHG) emissions (UNDP 2007; Naustdalslid 2011), and thus climate change and 'carbon management' has gradually gained prominence within the EM agendas (Kolk et al. 2008; Pinkse & Kolk 2012; Ventura et al. 2012).

Meanwhile, the social side of sustainability was not a key organizational concern and was hardly ever addressed in industry attempts at achieving SD and/or improving EM (Palmer et al. 1997). Previous research shows substantial difficulties associated with fully incorporating and operationalizing social sustainability features in various sectors (Boström 2012) and scholars argue that the concept of social sustainability has been particularly difficult to analyze, comprehend, and define (Lehtonen 2004; Littig & Grießler 2005).

From the mid-1990s, many businesses started to realize that they were ignoring the social side of the concept of sustainability and, as a result, they began to adopt practices of corporate social responsibility (Holliday et al. 2002). However, to date, the studies that explore the social side of SD within organizations in developing countries have been limited (Zeffane & Rugimbana 1995; Hopwood et al. 2005), and discussions have been dominated by US and European perspectives (Dobers et al. 2009).

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This article builds on this limited body of work regarding the social pillar of sustainability in developing and emerging countries and goes beyond the broader focus on the SD goal. It also provides a narrower assessment of the delivery of social benefits in organizations implementing Clean Development Mechanism (CDM) hydroelectricity projects in Brazil. The focus on the social pillar of sustainability refers to the suitability of CDM projects to produce co-benefits that generate social development at local scale, including aspects such as job creation, income distribution, empowerment of vulnerable groups, use of local natural resources, and social acceptability. Apart from this, the article focuses on organizations implementing hydroelectricity projects in Brazil, raising important questions for other organizations implementing other CDM project types, including agroforestry, fossil fuel switch, landfill gas, and non-hydropower renewable energy CDM projects, and even projects which are not within the CDM framework.

The CDM was designed, under the United Nations Framework on Climate Change Convention (UNFCCC 2011), with two explicit and equally important goals: to assist developed countries meet their emissions reduction commitments under the Kyoto Protocol in a cost-efficient manner and to provide SD for developing countries that host the emission reduction projects. Due to this dual objective, several studies have chosen CDM to explore all the economic, environmental, and social dimensions of SD (e.g., Olsen & Fenhann 2008; UNFCCC 2011). Overall, research suggests that while the economic and environmental sides of SD are generally achieved through the CDM, it does not contribute enough to generate social benefits (Olsen 2007; Schneider 2008; Boyd et al. 2009; Subbarao & Lloyd 2011; CDMPD 2012).

Despite this general conclusion, there are meaningful evidences that show the CDM projects' potential to foster social local development (IGES 2006; Sirohi 2007; UNFCCC 2011; Crowe 2013; Karakosta et al. 2013). With the adoption of a second commitment period at the Doha conference, the CDM projects are expected to constitute an important source of international offsets during the 2013–2020 period. Consequently, new research in managing organizations to synergize efforts to reduce GHG emissions while facing social development concerns is especially relevant.

The article is structured as follows. Section 2 introduces the situation of CDM projects in Brazil. Section 3 provides an overview of the current situation of organizational management for SD. Section 4 discusses the methodology used for the project assessment, while Section 5 presents the findings from desktop and case study analysis. Finally, Section 6 discusses the results, summarizes the major arguments in this article, and suggests further areas of research.

2. Status of CDM projects in Brazil

Brazil has had a visible, proactive, and influential role in the UNFCCC 2011 negotiations. The idea of CDM as a climate change mitigation instrument was initially proposed within the context of the international negotiations of the Kyoto Protocol by the Brazilian delegation in 1997, during COP 3, in the form of a Clean Development Fund (Cole & Roberts 2011). Later, Brazil was one of the first countries to establish the legal basis required to develop projects under CDM locally by creating its Designated National Authority (DNA) by an executive order dated 7 July 1999. It was the first nation to formally designate its national authority to the CDM Executive Board. The first methodology approved under the scope of the CDM by the Executive Board was Brazilian (Landfills – Salvador, Bahia state). Later, the first project effectively registered under the CDM also was Brazilian: the Nova Gerar project (Government of Brazil 2008).

Under the UNFCCC 2011 and the resulting Marrakesh Accords, CDM projects must be approved by the host country. Its DNA issues a Letter of Approval certifying that the proposed CDM project activity assists the host country in achieving SD. To guarantee the involvement of a wide range of stakeholders and the contribution to the local SD of Brazilian CDM projects, the Brazilian DNA requires project developers to include in their domestic submissions an additional document to the Project Design Document (PDD), the so-called Annex III. The Annex III document is a description of the project's contribution to SD and should describe the project's integration into the regional economic structure and the linkages to other sectors, the potential for energy generation, or the creation of synergic effects (CIMGC 2003).

Since the first Brazilian CDM project was registered by the CDM Executive Board in November 2004, progress in CDM project development has been spectacular, and on 31 October 2013, the CDM Executive Board had registered 352 projects in the country.

Meanwhile, when the empirical research of this article began, on 30 September 2011, the CDM Executive Board had registered 194 projects that represented 6% of all CDM projects registered throughout the world (Fenhann 2011). As can be seen in Figure 1, Brazilian projects by that date focused mainly on the following areas: methane avoidance (26%), biomass energy, and hydro (23.7% each).

The distribution by state of the project activities in the Brazilian CDM market reflects the general division of the country where the south and southeast are much more developed and industrialized than the thinly populated north (Fernández et al. 2012). Figure 2 presents the geographical distribution of the CDM projects registered by the time that the research began.

Brazil's effort to reduce GHG emissions by implementing CDM projects is underscored by the fact that 65% of projects are unilateral in other words, developed without the participation of Annex I countries (Government of Brazil 2008).

Previous research regarding the Brazilian carbon market suggests that there are complex reasons behind manager's decisions to pursue CDM investments. Adding a

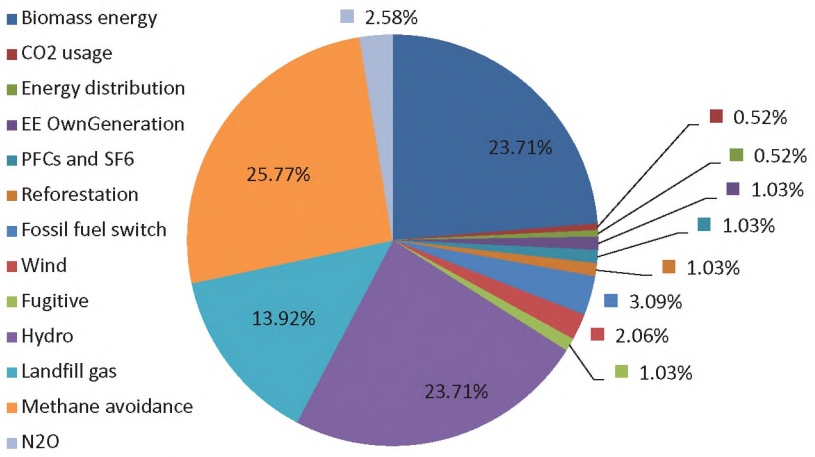

Figure 1. Registered CDM projects in Brazil.
Source: Author. Based on data from Fenhann 2011.

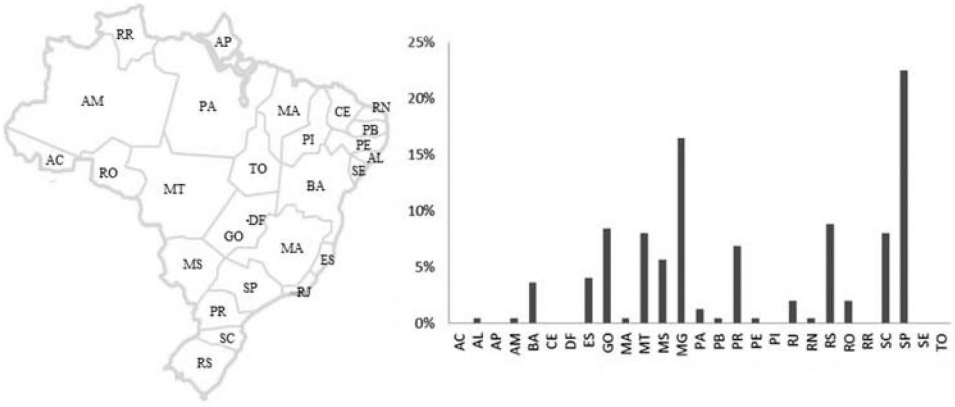

Figure 2. Geographical distributions of CDM projects in Brazil.
Source: Based on data from Fenhann 2011.

marginal increment to a project's internal rate of return appears to be one of the primary motivations followed by non-financial reputational factors (Silva-Junior 2011; de Freitas et al. 2013). To improve EM and diversify the activities of the firm are also identified as overall incentives (Silva-Junior 2011).

3. Organizational management for sustainable development

There is still no universally accepted definition of SD or an agreed basis for determining whether a specific action would contribute to SD. However, it is widely agreed that SD comprises three mutually reinforcing dimensions economic development, social development, and environmental protection (UNFCCC 2011) – and that the struggle around bringing 'meaning' to SD involves many groups, including governments, non-governmental organizations (NGOs), business organizations, and academics, all of 'which construct the meaning of the phrase in their own terms' (Eden 1994, p. 160).

Business organizations are talking about the topic of organizational management for SD since the World Commission on Environment and Development (WCED) report of 1987 (Elkington 1998). The emergence of the concept of sustainable business models was due to the desire of organizations to respect the environment and stakeholders because otherwise organizations need to make amendments to compensate their actions (Hawken 1993). However, SD innovation is often difficult and risky (Hall & Vredenburg 2003), and a change in the paradigm of their strategies is necessary to operationalize the concept of sustainability in business models, from maximizing profit (Stormer 2003) to also integrate social and environmental concerns (Robinson 2004).

In spite of difficulties, many organizations have revised their business models (Hall & Vredenburg 2003), and there are articles that present the results of empirical studies of making sustainable practices in business from different sectors. For instance, Hall and Vredenburg (2003) performed a field research of more than 40 companies from various industrial settings in some developed and emerging countries, including aerospace, agriculture,

chemicals, forestry, retailing, and the energy sector, to explore some of the underlying characteristics of innovation dynamics to achieve SD.

To obtain the aims of SD, there are three basic variables available for business organizations (Baumgartner & Zielowski 2004): organizational structure, formal management instruments, and organizational culture. Within the organizational structure responsibilities, tasks and procedures for SD have to be defined. Formal management instruments are, for example, the standards for EM like ISO 14,001, the European EMAS scheme, or other standards for quality management. Useful instruments for these purposes can be 'balanced scorecard' (Kaplan & Norton 1992), 'sustainability balanced scorecard' (Figge et al. 2002), and 'life cycle assessment' (UNEP-SETAC Life Cycle Initiative 2009).

Benefits of managing for SD have been rather explored in the companies' world, mainly on financial performance. Some studies have concluded that aligning organizations with SD is the key to business competitiveness and provides the opportunity to gain operative and strategic advantages and increase the reputation of both internal and external stakeholders (Tregidga et al. 2013). Nevertheless, literature review has revealed that there is a general lack of studies about issues concerning management for SD in other types of organizations different to companies, like governments, NGOs, or academics groups, although there are some exceptions, as the studies made by Beringer and Adomßent (2008) and Castro and Jabbour (2013), which analyze the contributions made by Higher Education Institutions for Sustainable Development.

In the last few years, there are many organizations that have focused on the environmental component of SD (Rondinelli & Berry 2000) and taken into account the aspects of EM in their organizational culture and structure. EM is defined as 'the organization-wide process of applying innovation to achieve sustainability, waste reduction, social responsibility, and a competitive advantage via continuous learning and development, and by embracing environmental goals and strategies that are fully integrated with the goals and strategies of the organization' (Haden et al. 2009, p. 12). But, as Jabbour et al. (2008) said, improving environmental conditions is fallacious without the real involvement of companies in this process. What is defended is the development of a socio-environmental perspective which aims at using resources efficiently, and conciliating economic growth, technological advances, and ecological limitations. However, traditionally, the social side of sustainability has not been widely considered within organizational concerns, and it has been hardly addressed in industry attempts at achieving SD and/or improving EM (Palmer et al. 1997).

Even in our days, literature about management for SD is much more reduced in organizations of developing and emerging countries (Dobers et al. 2009). This may be due to the fact that while organizations in developed countries have traditionally operated in a regulated environment, with numerous laws and regulations which governed their activities and make their directors accountable to a broader range of stakeholders (Deloitte 1992), organizations in developing and emerging countries faced constraints such as weaknesses in public administration and management or a lack of overall planning mechanisms (Zeffane & Rugimbana 1995). Hence, the existence of theoretical and practical understanding of how organizations can be managed in developing and emerging countries could be very important in order to contribute to achieve a really SD (Nelson & Prescott 2008).

Examples of identified organization management for social development benefits are the Bottom of the Pyramid (BOP) settings, which present potential ideal opportunities to connect business with sustainability in the developing world (Matos & Silvestre 2013). Also, corporate social responsibility practices have been previously highlighted to suppose a twist toward social sustainability in developing countries with weak institutional environment (Dobers et al. 2009).

Other examples of management practices can be found in the following sectors: (i) the manufacture organizations including social and environmental considerations in supply chains to reduce impacts and social exclusion (Hall & Matos 2010); (ii) the firms that have developed the ability to become socially embedded to create more total values (social and economic) and have a greater positive impact in a social context (Sanchez et al. 2006); (iii) the social enterprises which lead to SD through innovative approaches and creative thinking (Azmat 2013); and (iv) the efforts made by organizations to achieve a sustainable tourism development thanks to a better stakeholder engagement (Kent et al. 2012; Doiron & Weissenberger 2014).

In addition, good practices for social benefits in developing and emerging countries could also be found in some organizations which have implemented CDM projects under the Kyoto Protocol (Sutter 2003; Olsen & Fenhann 2008; Gangale & Mengolini 2011; Fernández et al. 2012; Karakosta et al. 2012, 2013; Crowe 2013).

However, further research is needed to understand how organizations can create value in developing and emerging countries through balancing economic, ecological and overall social elements, promoting equitable relationships amongst stakeholders (Boons & Lüdeke-Freund 2013).

4. Methodology

4.1. Project selection and sample size

The CDM has continued to evolve since the first registered projects in 2005. In order to reflect the most comprehensive social development benefits, all hydroelectricity projects registered in Brazil before the start of this research, October 2011, were selected as project sample. Hydroelectricity projects were chosen for three main reasons: (i) hydroelectric power plants produce over 80% of the country's electric energy (Government of Brazil 2012);

(ii) more than 25% of the CDM registered in Brazil by October 2011 were hydro projects (see Figure 1); and (iii) there are numerous different types of organizations directly related with the hydroelectric sector in Brazil.

Identifying the hydro CDM was relatively straightforward, as CDM registered projects are publically available and classified by host country in the CDM pipeline of the UNEP Risoe Centre (Fenhann 2011).Thus, the final database consisted of 46 hydroelectricity CDM projects.

As part of the research, 2 of the 46 projects were further investigated as case studies. The first case study is a small hydroelectric plant implemented by a local company in the state of Santa Catarina, in southern Brazil. The second one is a large hydropower plant, implemented by the Brazilian multinational Grupo Votorantim in the state of Bahia, in the north-east of the country (see Table 1 for case study project details).

This selection was done based on theoretical and not statistical reasons. Eisenhardt (1989) suggested that case studies *may be chosen to provide examples of polar types.* Thus, as it can be seen in Table 1, the two hydro projects were selected based on their intrinsic differences.

The case study research combined data collection through archival sources (e.g., PDD, memories of RSC of the companies, and webs of the companies), on-site observations, and interviews. A triangulation was applied by multiple data collection methods, which provides stronger substantiation of constructs and hypotheses (Stake 1995).

Interviewees were selected to gather a range of different perspectives and are listed in Table 1. In this way, it was sought to include for each project at least one representative from the following stakeholders: (i) project manager; (ii) local employee; and (iii) local authority. In addition, it was required to include at least two representatives of the local communities (e.g., head or communities or representatives of community base organizations or non-profit local organizations). Finally, 15 people were interviewed during the research.

It is important to take into consideration that hydroelectric enterprises have often proved to be social and environmentally unsustainable, both on an international and on a Brazilian level (Bermann 2007). However, the two projects are further studied because both of them placed an emphasis on social sustainability, although in a very different way and using different management practices.

4.2. *Development of social indicators*

Sustainability assessments and indicators aim to produce and communicate information needed for evidence-based policymaking, strategic planning, or learning (Lyytimäki et al. 2013).

In the absence of an appropriate ready-made set of social indicators to use for CDM project assessment, a number of methodologies that focus on assessing SD benefits from the CDM projects were analyzed for this study (Begg et al. 2003; Rezende & Merlin 2003; Sutter 2003; Sutter & Parreño 2007; Olsen & Fenhann 2008; Subbarao & Lloyd 2011; UNFCCC 2011; Fernández et al. 2012; Ventura et al. 2012). Eventually, the proposed indicators of the sustainability and empowerment model (S&E), as detailed by Fernández et al. (2012), were adapted and aggregated to create the indicators (see Table 2).

4.3. *Analyzing CDM projects documents for the delivery of social development benefits*

To assess CDM projects for the delivery of social development benefits, a desktop analysis of each individual project was conducted utilizing both the PDD and the Annex III document. As explained earlier, Brazil requests the so-called Annex III documents as part of their domestic submission of the CDM projects. To use these documents, allowed for a consistent means of assessment across all projects, with documentation publicly available

Table 1. Case study projects.

CDM project title	Location	Project type and subtype	Type of implementing organization	Scale	Activity description	Stakeholders' involved for the case study
Alto Benedito Novo Small Hydroelectric Project	Santa Catarina (South Brazil)	Hydro; Run of river	Cooperative	Small	Construction of small hydroelectric plant (renewable electricity generation)	1 project manager, 2 local workers, 2 members of a local cooperative, 2 local authorities
Votorantim's Hydropower Plant with existing reservoir 'Pedra do Cavalo' CDM Project	Bahia (North Brazil)	Hydro; Existing dam	Brazilian Multinational company	Large	Construction of electric substations, fabrication, and installation of turbines and generator	1 project manager, 2 company executives, 1 local worker, 1 local authority, 3 members of local cooperatives

Table 2. Proposed indicators to assess social development benefits at the local level in Brazil.

Indicator grouping	Indicator subsets
Financial benefits for the local economy	I1. Enhancement of local tourism
	I2. Equitable share of revenue from the CERs (with funds reaching the local communities)
	I3. Support for local entrepreneurial activity
	I4. Local or community cost savings
Local employment generation	I5. Local jobs generation
Investment in local infrastructure and basic services	I6. Building/ improved local infrastructure (e.g., roads or public buildings)
	I7. Access to clean and affordable energy
Development/diffusion of local/imported technology	I8. Development, use, improvement and/or diffusion of a new local or international technology
	I9. Collaboration with local universities or research centers for the development, use, or diffusion of a new local or international technology
Engagement of local population and generation of social capital	I10. Adequate mitigation measures of stakeholder concerns proposed by the project developer
	I11. Positive stakeholder perception of the project's contribution to the generation of improvements in the living conditions
	I12. Promotion of social harmony and social cohesion (e.g., by the creation/ promotion of new associations or cooperatives)
	I13. Increased awareness of environmental issues
	I14. Professional training of local workers
	I15. Migration reduction
Empowerment of vulnerable groups	I16. Vulnerable groups (women, indigenous, children, and people with disabilities) are intentionally included in processes, stakeholder participation, revenue sharing, and other project activities
Labor conditions improved	I17. Improvements in working conditions
Promotion of education	I18. Improving accessibility to educational resources (e.g., donating resources for local education and or increased funding for local education)
Promotion of health	I19. Reducing exposure to factors that impact health and safety (e.g., non-potable water, smoke), and/or changes that improve lifestyles.
	I20. Improving health service delivery in the community (e.g., by funding vaccination campaigns and or/ health and safety campaigns, buying equipment or supplies for hospitals, and so on)
Sustainable use of natural resources improved	I21. Avoiding deforestation, forest degradation, and land erosion
	I22. Enhancement of local biodiversity
	I23. Decreased pressure on natural resources
	I24. Promoting waste management (including reutilization and recycling)
Environmental pollution and risks reduced	I25. Reducing odor and noise pollution
	I26. Reducing the risk of landslides
	I27. Reducing the risk of fire and explosions
Improved air, soil, and/or water quality	I28. Reducing air pollutants other than GHG
	I29. Enhancement of water quality
	I30. Improvement of soil recovery/fertility

and accessible through www.cdmpipeline.org (UNFCCC 2011) website or through the CIMGC website.

Each CDM project was assessed against the indicators of Table 2, with the ultimate goal of discovering whether there were any explicit indications in the official project documents, that social development benefits would be delivered if any, to the organization itself or the local community where the CDM project is implemented.

Given the difficulty of providing an objective assessment of each indicator based on the information available at documentary level, no numerical scoring was provided during the desktop review. The decision to make for each of the SD criteria is 'positive contribution', 'no contribution', or 'negative contribution'.

However, this desktop approach presents significant limitations. Assessing the statements from various sections of the documents could involve some subjectivity because different analysts and assessment procedures may assign different indicators to a given social benefit. Intersubjective testing with a second analyst coding the same documents to check for deflected analytical results, although recommendable, was not possible due to the lack of resources. Hence, a single analyst assessed and assigned indicators for all projects. This solution was previously adopted in other studies based on a desktop analysis of PDD (e.g., UNFCCC 2011; Subbarao & Lloyd 2011).

In addition, a case study analysis of two registered CDM projects was carried out based on the findings from site visit information and actual data.

4.4. *Case study analysis*

To complement the desktop analysis and in order to assess the actual ground level social development impacts, detailed case studies of two registered CDM hydroelectricity projects with actual field data were carried out. The

case studies allowed gathering additional information based on field observations and on relevant stakeholders' understanding of the variables that govern successful social development benefits. As Matos and Silvestre (2013) stated, case studies are an ideal way to investigate sustainability issues because they allow the identification and analysis of insights from the diversity of stakeholders involved and the complexity of their relations.

The same set of indicators and the assessment criteria used earlier to assess the 46 registered hydro CDM projects was applied whilst assessing the social development benefits from the case study projects. Thus, during the on-the-ground research, semi-structured qualitative interviews were used, and the interview protocol was based on the indicators in Table 2.

As respondents from the organization (such as project developers, company managers, or technical advisors) may wish to overvalue the benefits to provide a better image, a balanced number of stakeholders were chosen for each of the case studies. Interviews were carried out with 15 stakeholders, seven in Alto Benedito Novo Small Hydroelectric Project and eight in Votorantim's Hydropower Plant, including directors, technical advisors, managers, employees, and representatives of the local communities (see Table 1). Additional data were captured to provide context and nuance to the corresponding data and conclusions from the perspective of different stakeholders. Combining the results of the desktop review with the case study analysis increased the credibility and validity of the results through cross verification and provided a more detailed and balanced picture of the situation (Yin 2008). In CDM research, the combination of both techniques is increasingly being used (e.g., Subbarao & Lloyd 2011).

5. Results

The results of the desktop and the case studies are presented separately in this chapter. First, the quantitative results from the desktop analysis of the social development benefits generated by the organizations are shown. Second, qualitative results of case studies are analyzed and triangulated with information from the desktop study.

5.1. *Findings from desktop analysis*

The initial objective in the analysis of the hydro CDM projects was to analyze how the organizations are delivering social development benefits. These social benefits can be achieved in both, the own organizations and the nearby communities.

Figure 3 presents the indicator groupings and the number of projects that impact on each of them. The results show that the social development benefits most frequently claimed by the organizations implementing hydroelectricity CDM projects are *Local employment generation, Engagement of local population and generation of social capital, Development/diffusion of local/imported technology* and *Invest in local infrastructure.*

In addition, *Financial benefits for the local economy* and *Sustainable use of natural resources improved* are also claimed by almost half of the analyzed projects.

Such beneficial positive claims far exceed those of *Empowerment of vulnerable groups, Labour conditions improved* and *Promotion of education and health.*

Overall, these results correlate with other studies where the local employment is the most prominent social benefit of CDM projects (e.g., Olsen & Fenhann 2008; Subbarao & Lloyd 2011; UNFCCC 2011). Table 3 contains a summary of the results based on the most frequently claimed indicator groupings.

Although the results presented above correspond to the information presented in both PDD and Annex III, it is important to point out that some aspects are specifically requested to be included in these documents. Actually, Annex III documents are almost a 'checklist' whereby project developers argue that their projects meet the prescribed criteria of job creation, improvement of working conditions, training, and income distribution (Cole & Roberts 2011). Thus, indicators directly linked with Annex III requirements are those that are most claimed within their corresponding groupings (Fernández et al.

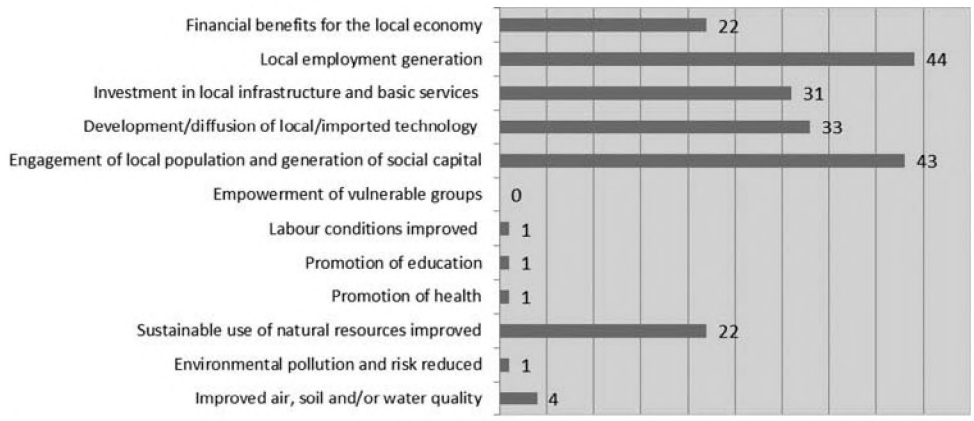

Figure 3. Social SD benefits obtained from the desktop analysis.

Table 3. Most frequently claimed social indicator grouping from the desktop analysis.

Social SD indicator groupings	Social SD indicator grouping in desktop analysis results
Financial benefits for the local economy	Results from the desktop analysis reveal that 22 of the 46 assessed projects have produced financial benefits for the local economy. In particular, around 40% of the projects have impacted on the indicator 'Support for local entrepreneurial activity'. These results were obtained due to the fact that hydro projects made use of the immediately and cheaply available local resources, which in turn appeared to have an economic impact on the community.
Local employment generation	PDD and Annex III information indicates that 44 of the 46 projects have contributed to the generation of local employment. Nevertheless, it is important to highlight that this indicator grouping encompasses both temporary and long-term jobs, as well as skilled and un-skilled jobs, because reviewed documents do not make any distinction between them. It is necessary for a deeper analysis to quantify each type of job created.
Engagement of local population and generation of social capital	Almost all the hydro projects examined (43 of 46) have had a marked influence in terms of engagement of local population and generation of social capital. 76% of organizations are being effectively used to increase environmental awareness (Indicator 13), and 36% have developed activities for the professional training of local workers (I.14). However, only 14% have implemented adequate mitigation measures of stakeholder concerns (I.10) and 17% of organizations have had a positive stakeholder perception in terms of the project's contribution to improve their living conditions (I.11).
Development/diffusion of local/ imported technology	Findings show that 69% of organizations have developed, used, and/or improved a new local or international technology (I.8) for the community through their projects. Surprisingly, the collaboration of the organizations with local universities or research centers (I.9) was found to be very low. Only one of the 46 revised projects have included this aspect, despite the potential of this type of collaborations to enable sustainable development at the local level.
Invest in local infrastructure and basic services	31 projects have contributed to better infrastructures and/or clean affordable energy for the community population. This may be due to the fact that hydropower plants have provided (in 63% of the assessed projects) to improve the access to clean and affordable energy (I.7).
Sustainable use of natural resources improved	Given its nature, hydropower plants are a type of project through which organizations can enhance improvements in the use of water as a local resource to generate electricity. But, beyond this aspect, little impacts have been produced on the local resources. Only 8% of the projects have contributed to enhance the local biodiversity (I.22), and any initiative has been found to decrease the pressure on natural resources (I.23).

2012). The case study projects were used to make a comparison between the social developmental benefits assumed in the PDDs against the actual benefits delivered on the ground.

5.2. *Findings from case study analysis*

The main findings of both case studies are presented separately, and then a systematization of the results has been elaborated to allow an automatic comparison.

5.2.1. *Alto Benedito Novo Small Hydroelectric project, Santa Catarina, Brazil*

The 'Alto Benedito Novo Small Hydroelectric Project' is registered as a CDM project since 2007. This is a small hydroelectric plant with installed capacity of 15 MW, located in the Benedito River, Santa Catarina State, Brazil. The purpose of the project's activity is to dispatch renewable electricity to the members of an agricultural cooperative, which is part of the company responsible for the project, CEESAM Geradora S/A. The project includes the exportation of the energy surplus to the interconnected grid, offsetting thermal generation with renewable electricity generation. Since the project consists of a run-of-river hydropower plant, it presents significantly less negative environmental impacts than large hydropower facilities, mainly because the project does not have a flooded area.

The results of the interviews show that most of the social impacts generated by the project are economical. Thanks to an agreement between CEESAM Geradora S/A and the municipality, the price of energy in the city of Benedito Novo is lower than the price in nearby communities. This price decrease has forested major business development and led to new business. In addition, the company has hired local staff for the operation, management, and repair services of the ifacility.

In addition, CEESAM Geradora S/A makes periodic donations of school supplies to the schools in the area, and with the money expected from the sale of carbon credits (when the project was visited in November 2011 the company still had not received any credit), it plans to invest in computers for those schools, which would help to improve local children's education. The selection of the materials to be donated to the schools is done taking into

account the opinions of different stakeholders of the school community.

The technology used for the project has been developed by the local company itself. Furthermore, there have been workshops with several stakeholders to explain the basis of the technology, and thanks to them, other small hydropower plants have been developed in the nearby communities.

Given its nature, the project contributes to the better use of local natural resources. However, it cannot be said that there is a direct contribution aimed at improving local environmental conditions. In relation to this, the representative of the company stated during an interview that reforestation activities are designed to be implemented when they get the money from the sale of carbon credits. It is important to highlight that the project has a clear environmental benefit due to the reduction of GHG which, in the absence of the project, would go into the atmosphere from power generation through fossil fuels. However, indicators designed for this study consider only benefits at local level, not the overall benefits produced.

Therefore, in general terms, CEESAM Geradora S/A relates to a sustainable business model where economic, environmental, and social values are created through the local and clean production of electricity.

5.2.2. *Votorantim's Hydropower Plant with existing reservoir 'Pedra do Cavalo' CDM project*

Votorantim's Hydropower Plant with existing reservoir 'Pedra do Cavalo' was registered as a CDM project in 2006. The project included the construction of electric substations and the installation of turbines and generators in a dam built in 1985, with the main objective of supplying the city of Salvador with water. The plant has an installed electric capacity of 162 MW and is located in the towns of São Félix and Cachoeira, in the state of Bahía, north-east of Brazil. The plant is owned by Votorantim Cimentos Ltda. and is administered by Votorantim Energia Ltda. Both are subsidiaries of the GrupoVotorantim, a Brazilian multinational company, which operates in several sectors such as finance, energy, siderurgy, steel, paper, etc. The Grupo Votorantim is present in over 20 countries and is one of the largest Brazilian industrial conglomerates.

It is very important to clarify that, as the power plant was implemented in an existing reservoir, the Votarantim's Hydropower CDM project adds a new function to the reservoir without resulting in additional environmental impacts. That is why the present assessment doesn't take into account issues associated with projects flooding large areas, such as additional GHG emissions from biomass decomposition, inequitable land loss, and forced relocations of neighboring populations.

Thanks to the project, an important number of direct jobs were created during the construction phase. In addition, indirect jobs were generated for the maintenance of the facility. It was found that the community was involved in all phases of the project. Votorantim carried out several public hearings with fishers, NGOs, public institutions, and private companies. The company also organized several visits to the plant so that stakeholders could understand the project.

A percentage of the money from the sale of carbon credits is destined to the Votorantim Institute, an organization established to underpin Votorantim Group's commitment with the communities in the aim of strengthening corporate and human capital. One of the activities carried out by the Institute is the investment in different business projects in the neighboring communities of hydropower plant 'Pedra do Cavalo'. The income generation programs implemented by Votorantim could be a successful model for these kinds of programs.

In the same manner as the previous case, the impacts resulting from the reduction of GHG emissions are not considered as local benefits, and the major environmental benefit is the improvement in the use of natural resources. However, the company implements environmental recuperation programs such as recovery of degraded areas, management of aquatic ecosystems, monitoring of water quality and fish fauna, and environmental education program.

Findings suggest that the community experience of the Votorantim Institute plays a key role in the success of its activities.

5.2.3. *Systematization of case study results*

The selected cases illustrate differences in context and organizational innovation approaches toward the incorporation of social sustainability in business models. However, despite the differences between the two organizations, both projects appeared to be relatively successful in terms of delivering the envisaged social development benefits to the local community as indicated in the PDD and Annex III.

Votorantim's case is an example of a large project managed by a multinational company that act to further the interests of others (including groups or societies of which they are part) to ultimately serve their own self-interest. However, the research highlighted that the social benefits of the project were implemented by a different organization. In fact, the ultimate objective of this so-called Votorantim Institute is precisely, to define corporate social responsibility practices to promote SD benefits within the local communities.

On the other hand, the important social benefits of the Alto Benedito Novo Small Hydroelectric Power Plant are due to its intrinsic characteristics: small project managed by a local company which is closely linked to the community.

Both companies have been able to manage their projects while maintaining its purpose and its structure, but in alignment with the needs of the communities in which they operate.

Table 4. Systematization of the results from case study analysis.

Identified practices/benefits	Alto Benedito Novo Small Hydroelectric Project	Votorantim's Hydropower Plant with existing reservoir 'Pedra do Cavalo' Project
Practices		
Community-based projects	Yes	No
Local stakeholder participation	Yes	Yes
Involvement of a foundation/NGO or a community-based organization.	Yes	Yes
Incentivized project developer (committed to SD and fight against poverty)	Yes	Yes
Project developer with good corporate social responsibility practices	No	Yes
Benefits		
Financial benefits for the local economy	Yes	Yes
Local employment generation	Yes	Yes
Investment in local infrastructure and basic services	Yes	Yes
Development/diffusion of local/imported technology	Yes	No
Engagement of local population and generation of social capital	Yes	Yes
Empowerment of vulnerable groups	No	No
Labor conditions improved	No	No
Promotion of education	Limited	No
Promotion of health	No	No
Sustainable use of natural resources improved	Yes	Yes
Environmental pollution and risks reduced	No	No
Improved air, soil, and/or water quality	No	No

Table 4 shows a systematization of the results from case study analysis, indicating the main differences and similarities between the two projects analyzed and the principal social benefits generated by each one.

6. Discussion and conclusions

The combined desktop and case study results of this research suggest that organizations managing hydroelectric initiatives in Brazil under the CDM are able to offer a pathway toward achieving a number of important social benefits. These social benefits were mainly found related to employment generation and revitalization of the local economy.

However, the research also identified that projects often failed to deliver significant or substantial long-term development benefits beyond the economic benefits on a local and regional scale. Thus, most of the assessed projects have not had any impact on the promotion of health or education, or contributed to the empowerment of vulnerable groups, such as women or children. These findings agree with previous studies about hydro CDM projects in Brazil and other developing countries (e.g., Cole & Roberts 2011).

The two projects for the case study analysis were chosen because, despite their differences, both of them were found to emphasize social sustainability although in a very different way and using different management practices. This allowed us to break down differences and similarities, and to systematize lessons learnt from two organizations that have defined their added values in concert with social sustainability in a different way.

Alto Benedito Novo is a small hydroplant managed by a local enterprise whose main activity is strongly linked with the social benefits for the community. Results from this case study allow us to understand how hydro projects can enhance the development of micro-enterprises as well as the revitalization of local economies. On the other hand, Pedra do Cavalo is a hydroelectric dam managed by a big Brazilian company, whose main activity barely provides direct social benefits and which has reinforced these social aspects as a part of its corporate social responsibility. The latter is an example of an alternative management procedure aiming to switch from community assistance to community development through the corporate social responsibility practices of the company. Both initiatives demonstrated to be beneficial in terms of raising community environmental awareness.

Overall, results suggest that the main shared strength is that social benefits are achieved by entities interested in local sustainability (i.e., a local cooperative and a foundation), resulting in a crucial effort to involve local stakeholders. We conclude that this involvement, albeit obtained in different ways, is a key aspect in achieving real social sustainable benefits for people and climate. This agrees with previous findings from other renewable energy CDM developing country studies (e.g., Cole & Roberts 2011; Subbarao & Lloyd 2011).

Furthermore, the research identified several challenges that are hindering the hydro CDM projects to deliver more social benefits and enabled a number of recommendations

to be extracted for the organizations to face those challenges:

(1) To promote the participation of a diverse number of local stakeholder groups, which provide better opportunities to learn and obtain innovative solutions.
(2) To encourage the collaboration and communication between different stakeholders and the organizations to coordinate sustainability efforts. When stakeholders collaborate and work in partnership, the chances of finding creative solutions are higher. At this point, cooperatives and NGOs should play an important role.
(3) To find effective mechanisms and spaces which facilitate active stakeholders' participation where they express their advice.
(4) To promote technologies which enable the sustainable use of natural resources to be improved, environmental impacts to be reduced, and the decrease of community dependency on external resources.
(5) To include both learning and skill building as part of the stakeholder relations process. It enhances the empowerment of the communities and increases their autonomy.
(6) To take into account, specifically, the particular needs of some vulnerable groups such as women and children. This prevents the contribution to increase iniquity and injustice.
(7) To strengthen the role played by local, regional, and national governments, which can implement monitoring mechanisms, tax exemptions, and other incentives to SD-oriented organizations.
(8) To raise awareness about the importance of SD.

The limitations of this work are linked to interviewees' ability to articulate facts and opinions and the small sample size of the case study. As earlier explained, to minimize such limitations, a variety of stakeholders were surveyed, and the information was triangulated with other references. Nonetheless, this research did not determine conclusively how organizations can be managed to meet the social development needs of local communities. Instead, it nuances the question to hydro projects in Brazil and calls for additional research to further evaluate practices to foster social benefits being implemented by organizations in developing countries both within and outside the CDM framework.

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